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United States Department of Agriculture,**BUREAU OF PLANT INDUSTRY.**

Forage-Crop Investigations,

WASHINGTON, D. C.

A ROTARY SEED HARVESTER FOR CRIMSON CLOVER.By A. J. PIETERS, *Agronomist.***DEVELOPMENT OF A ROTARY SEED HARVESTER.**

In 1912, the attention of Mr. J. M. Westgate, then in charge of the clover investigations of the Office of Forage-Crop Investigations, was called to the possibility of making a rotary harvester for crimson-clover seed.

The use of comb strippers was described and a brief account of the early work in developing such a rotary stripper was given by Mr. Westgate in Farmers' Bulletin 646. Since that date the pressure of other work has prevented Mr. J. F. Barghausen, of the Bureau of Markets, from perfecting the machine, and it has not yet been possible to perfect a universal attachment by which the essential parts can be placed upon any mowing machine. Such an attachment would be valuable and will undoubtedly be devised. It has seemed unwise, however, longer to delay the publication of the specifications for the rotary seed harvester for crimson clover as at present developed. (Figs. 1-7.) For the suggestions leading to the present machine, credit is due to Mr. Westgate, and for the development of these suggestions credit is due to Mr. Barghausen, in whose name the public-service patents have been taken.

During the winter of 1915-16 a complete machine was built and in May, 1916, it was shipped to Raleigh, N. C., in order that a thorough trial might be made. Mr. Barghausen and the writer went to Raleigh on May 17, 1916, and the machine was given a trial in a field of crimson clover placed at their disposal by Mr. William Wyatt. A number of persons interested were present, among whom were Mr. Clarence Poe, editor of the *Progressive Farmer*; Dr. B. W. Kilgore, director of the North Carolina Agricultural Experiment Station; Prof. C. B. Williams, vice director of the North Carolina Agricultural Experiment Station; Prof. R. E. L. Yates, of the North Carolina Agricultural College; Mr. T. B. Parker, superintendent of the State Demonstration Work; and Mr. C. R. Hudson, leader of the agricultural agents. The seed proved to be not fully ripe. A week later would have been a more favorable date for the trial.

The ground on which the test was made had been in cotton the year before, the clover having been seeded in the standing cotton. The surface was rough, on account of the ridges caused by cultivation, and more pronounced ridges were occasionally encountered, due to the terracing of the slope. These conditions and the sandy nature of the soil led to some difficulties, so that the speed necessary for the proper action of the reel could not always be maintained.

Owing to recent heavy rains the clover (besides being not quite ripe) was very wet. It was in good condition to be cut with a mower, but on the morning of the day of the trial the hulls would not strip. The testing of the machine was, therefore, delayed until afternoon, when the wind and sun had measurably dried the clover.

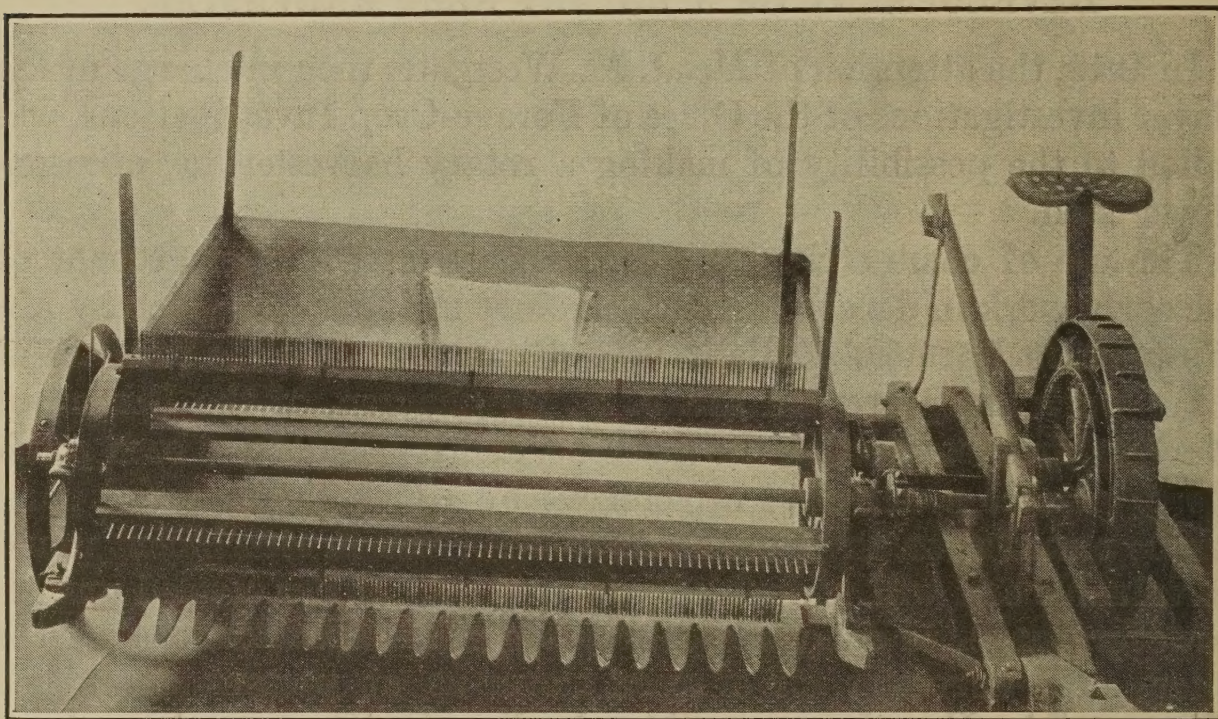


FIG. 1.—Front view of a rotary seed harvester for crimson clover.

CONCLUSIONS REGARDING THE VALUE OF THE ROTARY SEED HARVESTER.

It will not be necessary here to go into the details of the trial. Suggestions were freely made by those present, and the points made below summarize the opinions expressed and the conclusions that seem to be warranted by the trial. At a later date the machine was further tested by Prof. Yates, of the North Carolina College of Agriculture and Mechanic Arts, and his report is included in the following summary:

(1) A machine of this type will do its best work when the ground is reasonably level and the clover ripe and dry. The guide teeth, figures 2 and 3, *M*, are made to run near the ground, so as to engage any low or down clover (fig. 4), and when the ground is ridged they often cut through the soil, thus reducing the speed and stopping the reel. A lever (fig. 2, *O*), has been provided, so that the operator may lift the guide teeth, but when ridges are frequently and suddenly encountered it is not always possible to manipulate this lever quickly enough. The entire body of the machine is also necessarily hung low, and on ridged soil this frequently causes great friction, especially when the drivewheel (fig. 2, *C*) happens to drop into a hollow or furrow.

It should be stated, therefore, that persons contemplating the harvesting of crimson-clover seed with a machine of this sort should sow the seed on a piece of fairly level ground. This harvester strips the hulls from the heads and leaves the stalks, and the hulls will not strip unless ripe and dry. To use a rotary stripper the clover should be left standing until at least 75 per cent of the seeds are ripe.

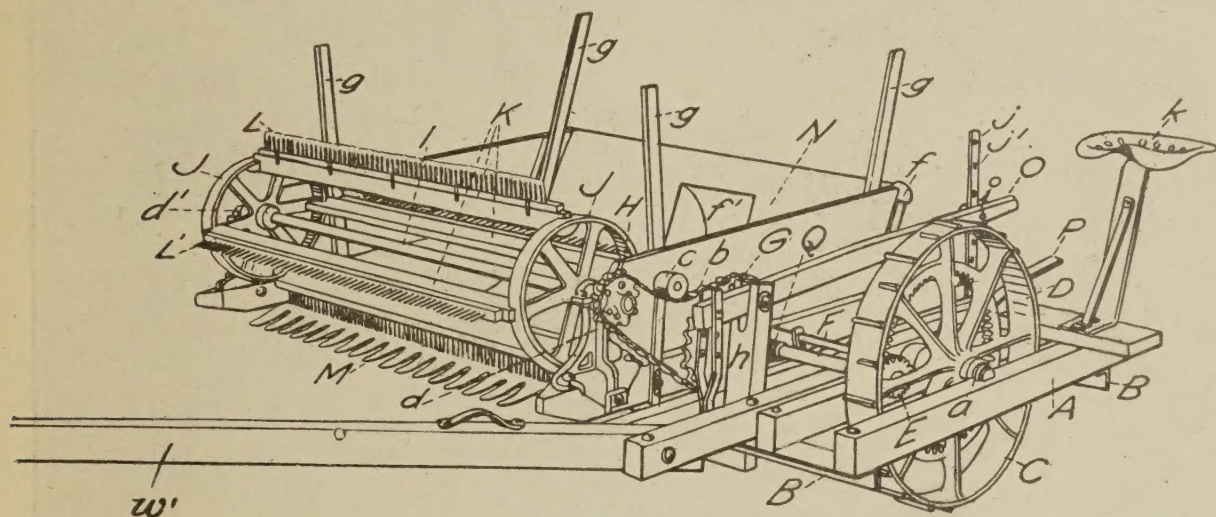


FIG. 2.—Details of construction of a rotary seed harvester for crimson clover.

(2) When the clover is ripe and dry the rotary stripper will get upward of 90 per cent of the seed. Very little seed was left on the ground. When the seed crop is cut with a mower and raked, a considerable portion of the seed is always left on the ground.

(3) A considerable acreage can be harvested in a short time; consequently the clover can be left until ripe and a favorable day awaited. On the farm

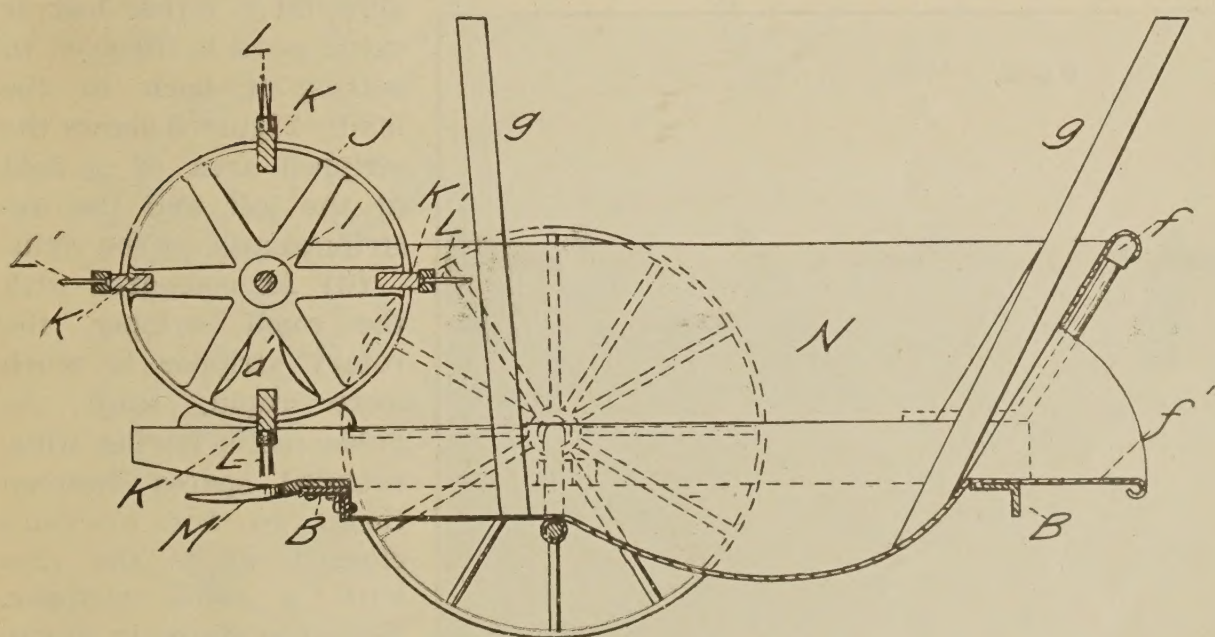


FIG. 3.—Cross section of a rotary seed harvester for crimson clover, showing details of construction.

of Prof. Yates about 7 acres were harvested in less than a day, and it is believed that under favorable conditions nearly 10 acres a day can be gathered. Standing clover is little damaged by any but a heavy rain, while after the clover is cut a light rain continued for several days may ruin the crop. When a seed crop is cut with a mower the clover must be a little underripe, in order to minimize the loss from shattering. The clover must then lie for a day or two before it is raked, and if during this time showers come great damage to the seed may result.

(4) From these tests it appears that at least as many acres can be harvested in a day with a rotary stripper as with a mower, and probably more,

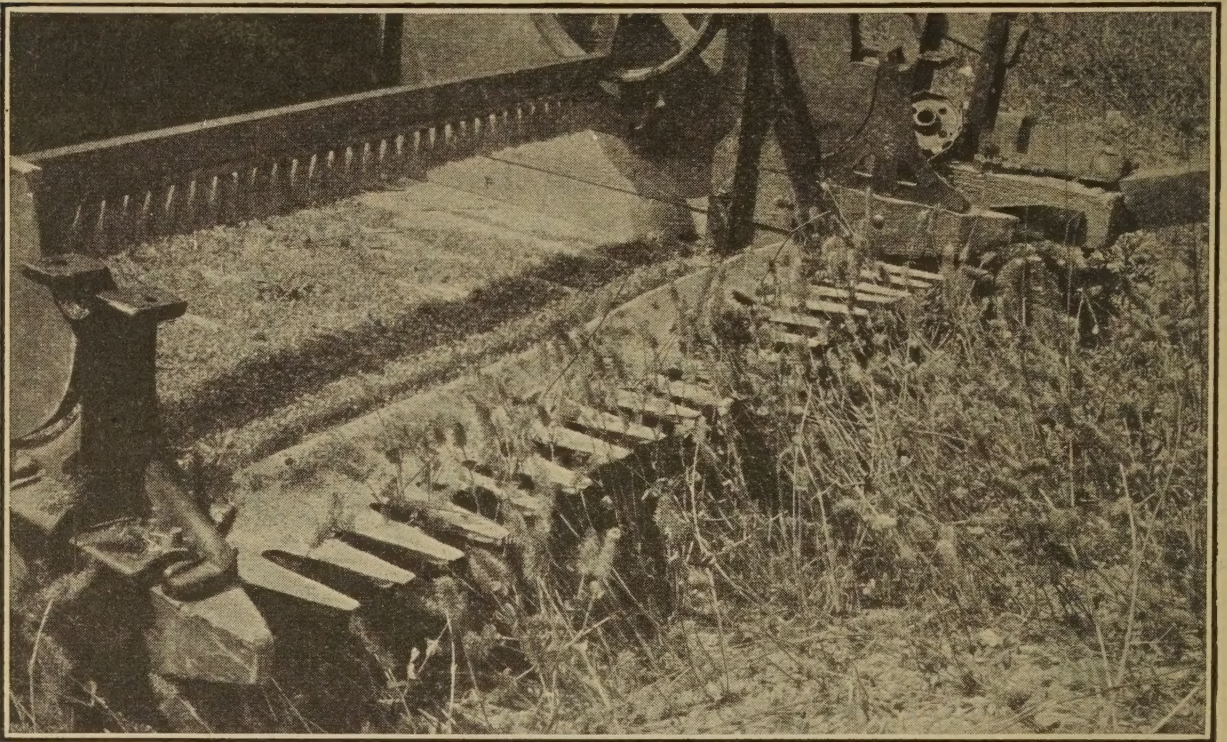


FIG. 4.—Guide teeth of a rotary seed harvester for crimson clover, showing how the clover heads are engaged.

and when the stripped pods are sacked the work is done, thus saving the extra labor of raking, stacking, and thrashing involved in the old method.

(5) When the rotary stripper is used, the stalks and leaves are practically all left on the ground to be turned under, while by the old method this material is either lost or

extra work is involved in getting it back to the land. Figure 5 shows the stripped area of a field at the left and the unstripped area at the right.

(6) As compared with the comb stripper, the rotary stripper is much more rapid, since the guide teeth, having wide, rounded spaces between them, do not become clogged, as is the case with a comb stripper. Westgate states in *Farmers' Bulletin 646* that a comb stripper will gather the seed from about 2 acres a day. The rotary stripper will do four times as much work. It must be said, however, that when only a small piece of clover is to be handled

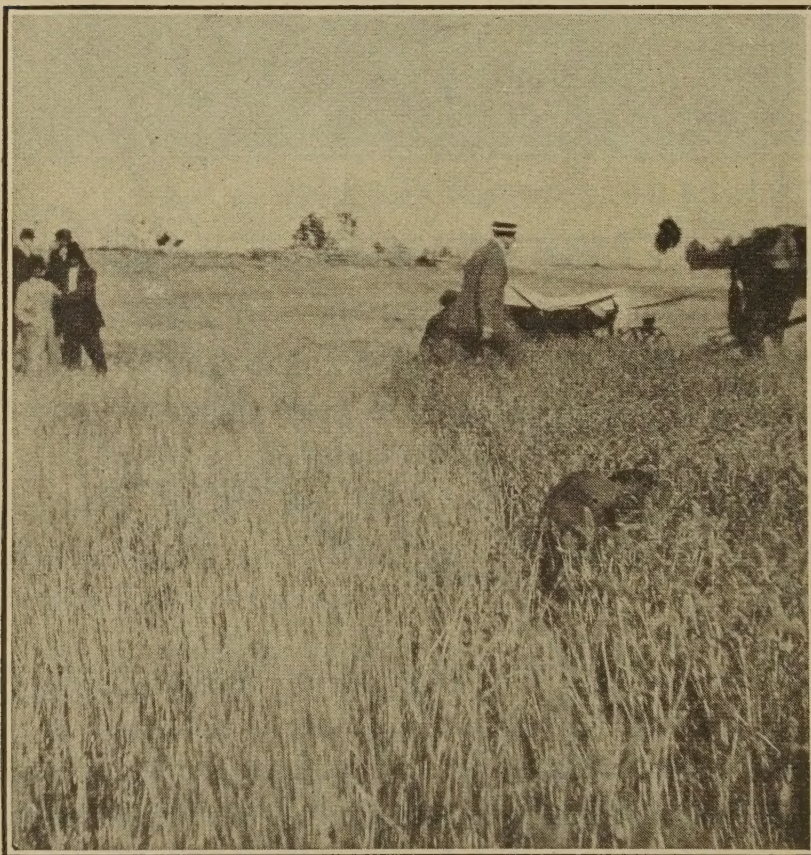


FIG. 5.—A field of crimson clover, showing the area stripped of its seed heads (at the left) and the unstripped area (at the right).

and time and labor are not important considerations, the use of the comb stripper, which can be made at home at a small expense, is to be advised.

(7) A number of the cast-iron teeth in the trial machine were broken when stones were encountered. It is recommended, therefore, that these teeth be made of malleable iron.

LATER IMPROVEMENTS ON THE ROTARY SEED HARVESTER.

Since the date of the trial above referred to an improvement upon the machine has been made, as shown in figures 6 and 7. This im-

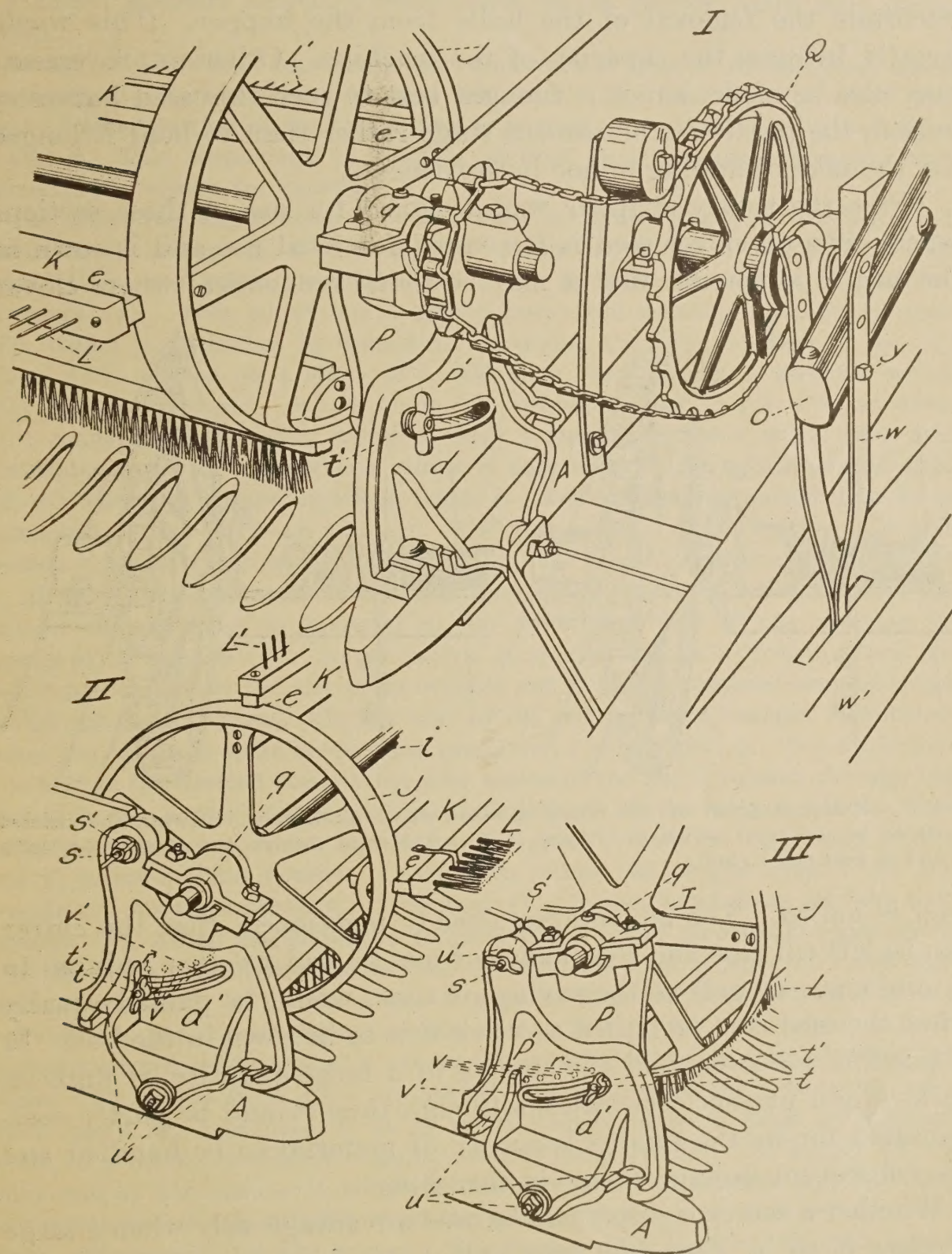


FIG. 6.—Adjustable hanger of a rotary seed harvester for crimson clover: I, Perspective view, showing the sprocket wheel and lifting bar; II, detail view, showing the grooves for steel brushes; III, details of construction of the adjusting device.

provement consists of a device for raising and lowering the reel which holds the brushes. The greater the distance the brushes can work above the guide teeth, the less will be the friction. If the clover is

dry and the hulls strip readily, the brushes may be raised so as to strike the heads only, while if the hulls strip with difficulty, the brushes should be set lower, so as to give them a longer sweep of the heads.

Certain improvements and additions will naturally suggest themselves to those who use the rotary stripper. It may be possible to facilitate the removal of the hulls from the hopper. This would greatly increase the capacity of the machine. Other improvements may also be made, but it is thought best to turn this seed harvester over to the public at the present stage rather than to hold it longer for the sake of adding minor improvements.

While the rotary stripper was designed for use in those sections where crimson-clover seed is harvested for local use and is sown in the hull, it is possible that it may be found economical where clover

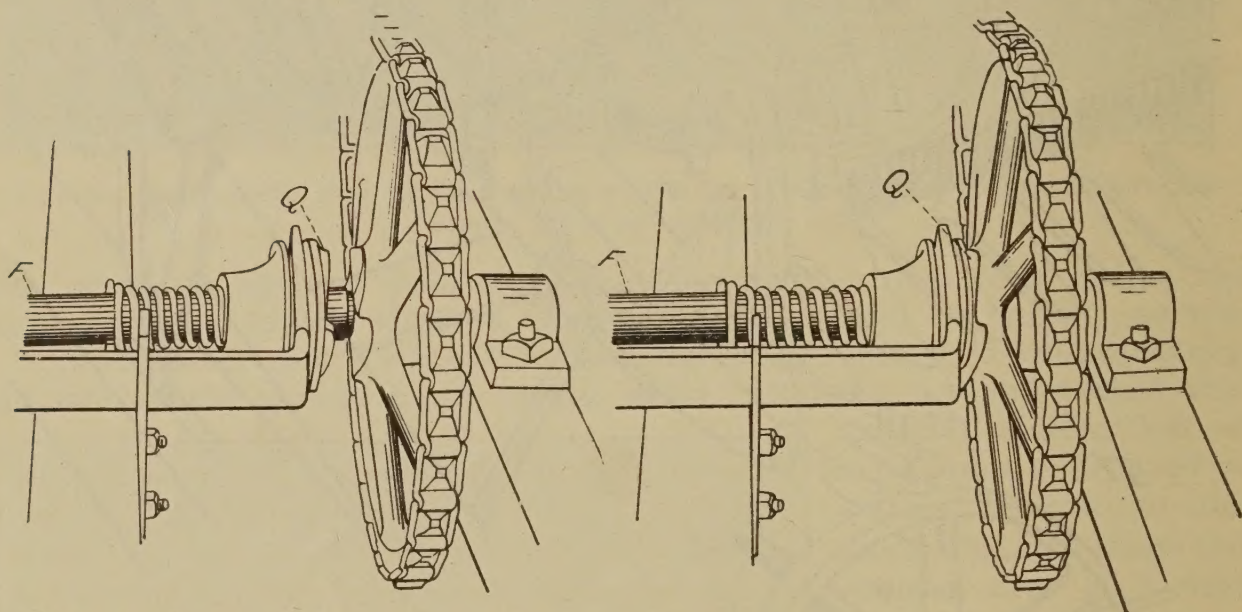


FIG. 7.—Enlarged detail of the larger sprocket-wheel mechanism, showing the ratchet clutch by means of which the rotary seed harvester is thrown out of gear (at left) and in gear (at right).

seed is hulled. The advantages already mentioned, that the clover can be left till ripe and the chance of loss by bad weather reduced to a minimum, as well as the saving of time, would be gained equally when the seed is to be hulled as when it is to be sown in the hull. It is possible, however, that the storing of a large quantity of hulls in sacks might present difficulties, although these would be partly compensated for by the smaller quantity of material to be handled and the consequent saving of time in thrashing.

Whether a rotary stripper can be used advantageously when a large acreage is to be harvested and hulled can be determined only by further trials.

DESCRIPTION OF THE ROTARY SEED HARVESTER.

The following description has been adapted from Mr. Barghausen's application for a patent and covers all information, when read

in connection with the figures, necessary for constructing this machine:

Figure 2 shows a perspective view of the rotary seed harvester.

Figure 3 shows a cross section of the machine, including the rotary steel brushes, pegged strips, guide teeth, and hopper bed.

Figure 6 presents three views of the adjustable hanger, in the upper one of which the sprocket wheel and lifting bar are included.

Figure 7 presents details of construction of the ratchet clutch gear mechanism.

In figures 2 and 6, *A* represents the framework or base of the machine, made preferably in part of heavy timbers and iron. The iron part, to which the heavy timber portion of the framework is secured, is designated as *B* in figures 2 and 3. This framework is suitably secured to a crosspiece properly connected with wheels for carriage.

The following explanation has reference to figure 2 and to the enlarged views of certain parts of the machine shown in figures 6 and 7: The iron wheel *C* is constructed preferably 30 inches in diameter and set in suitable bearings (*a*). This wheel has a ribbed tread and contains an internal gear (*D*) which is 20 inches in diameter. Engaging the internal gear is the cog wheel (*E*), carried on a shaft (*F*), which, in turn, carries a sprocket wheel (*G*) at the other end. A link chain (*b*), which is kept in place by an idler (*c*), connects the sprocket wheel *G* with a smaller sprocket wheel (*H*) and transmits power to a shaft (*I*), which is supported by the adjustable hangers (*d*, *d'*) shown in greater detail in figure 6. Each adjustable hanger (fig. 6) is composed of two parts (*p* and *p'*). The part *p* has a shaft bearing *q*, a projection *r*, a bolt *s* carrying a winged nut *s'*, and a bolt *t* carrying a winged nut *t'*, all of which parts are hereinafter more fully explained. The part of the hanger designated *p'* is fastened to the framework (*A*) of the machine by means of three bolts (*u*). In the part *p'* is an aperture (*u'*) through which the bolt *s* passes and by the aid of the winged nut *s'* forms a pivoted connection on which the shaft *I* turns. On the rear of the part *p'* are a number of indentations (*v*) so made as to receive the projection *r* of the part *p*. The projection *r* is held in the desired indentation *v* by means of the bolt *t* passing through the slot *v'* in the part *p'*, being held in fixed position by the winged nut *t'*. This adjustment serves to raise and lower the shaft *I*, and the tightening of the nut *t'* forms a rigid hanger. Carried on either end of the shaft *I* are the wheels (*J*) having a plurality of grooves (*e*). In the model there are four such grooves (*e*), which are employed to receive the easily detachable cross strips (*K*) to which are alternately secured two rows of steel brushes (*L*) and dual rows of iron pegs (*L'*). The strips *K* may be fastened to the wheel *J* in any suitable manner, preferably by means of two set screws. The wheel *C* is so geared that one revolution of it causes the wheel *J* to rotate approximately ten times. The guide teeth (*M*) are spaced and secured to the framework (*B*). These teeth are separated so as to provide space between them of sufficient width to prevent choking or clogging even by large weeds. The hopper (*N*) is supported by the member *f*, which is fastened to the framework (*A*) and may be constructed of any suitable material, preferably iron pipe, and so made as to form a framework for the hopper. The hopper (*N*) receives the seed, which may be removed from it by brushing or sweeping the seed through the opening *f'*. This opening may be made of any suitable size or shape and may be cut in any portion of the back of the hopper for convenience in removing the seed. Secured to the hopper body are the strips *g*, designed to support a canvas cover, if needed, for use in harvesting tall clover. The handle bar *O* serves to raise and lower the guide teeth (*M*) by means of pivoting the whole machine

on the center of the framework (*A*), which is centered at the shaft *a* of the wheel *C*. Secured to the framework (*B*) is the member *h*, which serves as an axis on which to raise and lower the guide teeth (*M*). The iron strips *w* are secured at one end of the tongue *w'* and at the other end to the handle bar *O* by means of the bolt *v*. An iron strip (*j*) attached to the under portion of the framework (*B*) serves to hold the handle bar *O* in any position desired by passing a bolt through the aperture *o* in the handle bar *O* and through any of the openings *j'* in the strip *j*. The lever *P* serves to throw the machine out of gear by means of the ratchet clutch *Q* engaging the shaft *F* (fig. 7). The seat *k*, suitably secured to the framework (*A*), is adapted for use by the operator of the machine.

The machine may be drawn by horses or may be propelled by any suitable power. The height of the guide teeth (*M*) from the ground is regulated by means of the handle bar *O*. When the guide teeth have been adjusted to suit the height of the clover in a particular field and come in contact with the clover heads, the machine being in gear, the rapidly revolving wheels *J*, carrying the brushes *L* and the pegs *L'*, strip the seed hulls from the clover heads, the strips *K* being alternately equipped with the brushes *L* and the pegs *L'*. The brushes (*L*) are made of closely set stiff wire and the pegs (*L'*) are made, preferably, of a single row of steel pegs set about an inch apart. The alternate action of these brushes and pegs serves to strip the seed hulls from the clover heads. In case the harvester is self-propelled, it would be necessary to place an idler wheel (not shown) under the tongue (*w'*), in order that the guide teeth (*M*) could be raised and lowered by means of the handle bar *O*.

In operating the machine in any particular field, two adjustments are necessary. The first adjustment is the raising or lowering of the guide teeth (*M*) so that the clover heads will appear just above them. This adjustment is effected by elevating or lowering the handle bar *O* to the desired position and then inserting a bolt through the aperture *o* in the handle bar *O* and through any corresponding opening in the strip *j*, as already described. The second adjustment is made by means of the adjustable hangers *d* and *d'* and serves to regulate the height of the brushes *L* and pegs *L'* above the guide teeth (*M*), this adjustment depending upon the green or ripe, wet or dry condition of the clover when harvested. In figure 6 the adjustable hanger is shown at its lowest point at *II* and at its highest point at *III*. Adjustment is made by pivoting the part *p* on the bolt *s*, so as to insert the projection *r* on the part *p* into the desired indentation *v* in the part *p'*. The bolt *t* of the part *p* passes through the slot *v'* in the part *p'*. The adjustment is held in place by tightly screwing up the winged nuts *s'* and *t'*, thus forming a rigid hanger and permitting the shaft carrying the brushes *L* and the pegs *L'* to be adjusted as may be desired. The adjustment is made at the distance desired from the guide teeth (*M*) according to the condition of the crop, as already mentioned. By making these two adjustments, as described, the removal of the clover seed is accomplished with a minimum of injury to the plant. The wheels *J*, carrying the brushes *L* and the pegs *L'*, respond to the movement of the carriage wheels upon which the machine is mounted and revolve the brushes and pegs, thereby causing them to gently sweep or brush the clover heads engaging the guide teeth (*M*), stripping the hulls from the clover heads and brushing them rearward into the hopper (*N*).

Approved:

WM. A. TAYLOR,
Chief of Bureau.

FEBRUARY 4, 1918.